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Dichotomous qualitative response models of Federal Reserve policy adoption utilizing data generated from a vector autoregression

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DICHOTOMOUS QUALITATIVE RESPONSE MODELS OF FEDERAL RESERVE POLICY ADOPTION UTILIZING DATA GENERATED FROM A VECTOR AUTOREGRESSION

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Dichotomous qualitative response models of Federal Reserve policy adoption utilizing data generated from a vector autoregression

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CHAPTER I. INTRODUCTION

Economists have always shown a desire for insights into the policy formation of government agencies. The Federal Reserve, in particular, has been under intense scrutiny since its inception, not only because of its powerful short-run effect on total demand and income determination, but also because its decisions are made in closed meetings with little explicit Congressional guidance.

The lack of specific Congressional directives toward Federal Reserve policy is expressed in the Employment Act of 1946. This legislation suggests the broad goals of monetary policy (high employment, stable prices, and economic growth), but it contains no statement of priorities within this group of economic goals. Consequently, the Fed must independently establish the priorities when a situation arises where it is impossible to satisfy all goals simultaneously.

Federal Reserve independence was further established by the Federal Reserve-Treasury Accord of 1951. The Federal Reserve-Treasury Accord freed the Federal Reserve from its subservient relationship with the Treasury. In the ten years prior to the Accord, the Federal Reserve was responsible for the stability of the bond markets due to heavy and frequent borrowing by the Treasury for the war effort. The Fed was considered to be "pegging the interest rate" during this period.

In the 1970s, legislation[1] that attempted to give Congress more input into the development of monetary policy has been harshly criticized by Milton Friedman. Friedman is disappointed with the results of this legislation because he believes it has been ineffective in reducing the discretionary powers of the Fed [15, pp. 107-109].

It is, therefore, generally accepted that the Federal Reserve has short-run discretionary powers. If Federal Reserve decision making is independent of the elected branches of government, what are the Fed's objectives of monetary policy? This question alone creates incentive for researchers to attempt to quantify the reaction of Federal Reserve policy to economic conditions. But, there are more important reasons to study Federal Reserve policy objectives besides mere curiosity.

One reason often cited is that most econometric models of the macroeconomy assume exogenous Federal Reserve behavior. But, if the Federal Reserve reacts systematically to current[2] economic conditions, then monetary policy should be endogenous to the model. If Federal Reserve behavior is assumed to be exogenous when in fact it is endogenous, then econometric models with exogenous monetary policy are misspecified and policy multipliers will be biased.[3]

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[1]This reference is to House Concurrent Resolution 133 (1975), the Federal Reserve Reform Act (1977), and the Full Employment and Balanced Growth Act (Humphrey-Hawkins Act) (1978).

[2]"If, however, stabilization policy is endogenous but reacts only to lagged quarterly values of the target variables, this bias will not exist" [16, p. 176].

[3]For a more complete discussion of this source of bias in multipliers, see Goldfeld and Blinder [19].

A more recent incentive to study Federal Reserve policy formation stems from the rational expectations literature. If Federal Reserve policy reacts systematically to economic conditions, then rational economic agents will incorporate this information into their decision making, which will in turn affect the impact of policy on the economy.[1] A related concept deals with the expectations of policy formation when separate policy makers are attempting to influence the same macroeconomic variables. Suppose both the Federal Reserve and Congress are attempting to affect national income. If Congress has no knowledge (or imperfect knowledge) of the Fed's policy intentions, Congress will select a suboptimal fiscal policy.[2] Therefore, Congress has incentive to predict Federal Reserve reactions to the state of the economy when developing fiscal policy.

Federal Reserve policy formation has also been studied with the intent of discovering whether the Fed is influenced by the political election cycle. It would clearly be unethical for the central bank to manipulate the macroeconomy for partisan political objectives.

There is one additional reason to study Federal Reserve policy creation. The last 15 years have seen intense argument over what should be the proper operating strategy of the Fed. As a result, the Fed has moved away from a money market strategy and toward a monetary aggregate strategy. In addition, bouts with inflation have pressed the Fed toward

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[1] For a discussion of the role of expectations in macroeconomic models, see Swamy, Barth, and Tinsley [43].

[2] For a theoretical explanation, see Adam [2].

targeting monetary aggregates. Specifically, in early 1970 and again in October 1979 the Federal Reserve has announced that it is targeting monetary aggregates. This change in strategy may affect how the Fed reacts to the state of economy.

For all of the aforementioned reasons, economists have estimated Federal Reserve reaction functions of the following general form:

$$P = f(w, x, y, z) \tag{1.1}$$

where P is the policy instrument (or indicator of policy intent) assumed to be entirely controlled by the Fed; and w, x, y, and z are the ultimate macroeconomic goal variables (or intermediate targets) to which the Fed is hypothesized to react. Federal Reserve policy has often been assumed to be reflected by monetary aggregates, various forms of the monetary base, types of reserves, open market interest rates, or the federal funds rate. The macroeconomic goals to which the Fed is supposed to react are usually specified as growth in output, inflation, unemployment, and the balances of payments, or proxies and variations of these. The estimation of a reaction function such as this will generate coefficients that may shed light on the weights the Fed attaches to the objectives of monetary policy.

Many previous studies of the objectives of monetary policy have three inherent weaknesses. Two of those weaknesses occur in the specification of the policy indicator, while the third relates to the specification of the goal variables.

First, most studies assume the Fed is operating under a money market strategy or a monetary aggregate strategy. However, if a money market policy indicator is used while the Fed is actually targeting monetary aggregates, then the coefficients generated will have little meaning. This is also true if the situation is reversed. Also, over time, the Fed may switch strategies, which would make either specification of strategy incorrect.

Second, for reliable reaction function coefficients to be generated, the Fed must have total control over the policy instrument. That is, there can be no difference between actual and intended policy. Researchers testing political business cycle hypotheses have shown that unexpected federal deficits may cause the Fed to passively monetize the debt if they are operating under a money market strategy [27, p. 66]. Alternatively, these deficits may cause interest rates to rise if the Fed is pursuing a monetary aggregate strategy. In either case, intended policy may deviate from actual policy (as measured by monetary aggregates or open market interest rates) due to the federal budget deficit.

Third, many studies attempting to discover the objectives of monetary policy by observing how the Fed reacted to macroeconomic conditions use macroeconomic data that is concurrent with the policy decision. Researchers using concurrent macroeconomic data implicitly assume the Fed has perfect foresight. Alternatively, researchers using lagged or autoregressively formed data may have underestimated the forecasting abilities of the Fed. In either case, these studies fail to allow the Fed to react to economic information it may have known when it made a policy decision.

In this paper, I will develop a Federal Reserve reaction function while avoiding the three weaknesses just described. I will use a dichotomous policy instrument variable of "easy money" and "tight money" created from an evaluation of the Record of Policy Actions of the Federal Open Market Committee. This will avoid the two monetary indicator problems, previously discussed, altogether. In addition, I will use forecasts of macroeconomic data generated from an unrestricted vector autoregression (VAR) model. This method of data generation will be explained further in Chapter III. The VAR model will provide data for a reaction function where the Federal Reserve is reacting to information about the economy it may have known at the time of its policy decision.

This study is concerned with how the priorities of monetary policy change in response to economic conditions. This can best be accomplished by observing how Federal Reserve intentions (as measured by FOMC directives rather than an intermediate target) react to economic conditions the Federal Reserve could have known at the time it made its policy decision.

In Chapter II, I will review the literature on monetary policy reaction functions. I will present my model in detail in Chapter III. In Chapters IV and V, I will report the econometric results of this model, and I will summarize the forecasting methods in Chapter VI.

CHAPTER II. REVIEW OF THE LITERATURE

There have been many studies which attempt to quantify the reaction of monetary policy to the state of the economy. In this chapter, I will briefly review the major papers that deal with monetary policy reaction functions. At the end of Chapter II, I will summarize these studies in Table 2.1a and Table 2.1b. These studies are presented in chronological order.

William G. Dewald and Harry G. Johnson [11] were the first to apply the concept of a monetary policy reaction function to United States data.[1] They studied the post-Accord period of 1952 through 1963 by relating each of three indicators of monetary policy (money supply, open market interest rates, and member bank reserves) to proxies of the four objectives of monetary policy (price stability, high employment, growth, and balance of payments equilibrium). Their best results were obtained using the money supply as the monetary indicator, but they noted that "*this does not necessarily establish the money supply as the control* variable actually used by the monetary authorities" [11, p. 174]. Dewald and Johnson conclude that during the period 1952-1961, unemployment and economic growth were the main concerns of monetary policy.

Thomas Havrilesky [20] developed a monetary policy reaction function for the period 1952 to 1965 with two important distinctions from previous

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[1]Credit is given to Dr. G. L. Reuber [41] for the creation and first application of a monetary reaction function which was applied to Canadian data.

attempts. First, while using quarterly data, he assumed a one-period lag in the explanatory or objective variables. This was to insure unilateral causality. Secondly, Havrilesky used total reserves adjusted for changes in the legal reserve requirements as the monetary indicator. This was done because "free reserves, the money supply, and interest rates are somewhat ambiguous indicators of policy action as they often reflect market phenomena which are independent of monetary policy action" [20, p. 299]. The objectives of monetary policy were determined to be nominal income, unemployment, stable prices, and balance of payments surplus. All were found to significantly affect monetary policy with the exception of the balance of payments surplus.

In a study of Federal Reserve policy, John H. Wood [51] viewed the monetary authorities as an economic agent similar to firms or consumers. Specifically, Wood assumed a disutility function which the Fed seeks to minimize. The arguments in the function were the squared deviations of the current values from the targeted values of income, unemployment, balance of trade, and the price level.[1] For the monetary indicator, Wood used the change in the quantity of government securities held by the Federal Reserve. Wood concluded that during the period 1952 through 1963, the Fed responded to changes in the price level, nominal GNP, and the balance of trade.

In response to the Dewald and Johnson [11] paper, James W. Christian [9] developed a monetary policy reaction function. Christian believed

[1]This method has been criticized because it weighs positive and negative deviations from the target value equally; for example, equal disutility from "too little" inflation as "too much" inflation.

that Dewald and Johnson made two critical errors. First, reaction function coefficients may represent both the effect of monetary policy on the policy objectives and the relative weight the Fed attaches to these objectives (due to reverse causation when using quarterly data), and second the Dewald and Johnson model did not test for regression coefficient stability. Christian's solution was to use 20-observation moving averages for each independent variable to aid in grouping the data into "periods of concern" about inflation, unemployment, growth, and balance of payments disequilibrium. These periods are the cyclical peaks and troughs of the independent variables. Then, moving regressions were run to test coefficient stability during different periods of concern. The monetary indicators used were the money supply, free reserves, and the treasury bill interest rate. Christian's results for the period 1952 through 1966 suggest that the reaction function coefficients were not stable. Therefore, while the growth objective was significant throughout this period, the price stability, balance of payments, and employment objectives were intermittently important determinants of monetary policy.

Michael Keran and Christopher Babb [25] developed a monetary policy reaction function in an attempt to explain the apparent discrepancy between stated monetary policy and Federal Reserve action. They believed that stated monetary policy intent (as measured by FOMC directives) deviated from actual policy (as measured by the monetary base) because actual policy must account for two additional objectives of monetary policy not discussed in Federal Reserve policy statements. These two objectives were referred to as "even-keel" (or "making a market" during treasury debt financing) and "financial stability" (or being the "lender of last resort" during a financial panic). All other objectives were grouped into the category of "stabilization policy" (employment, inflation, growth, and balance of payments). Keran and Babb tested the effects on monetary policy of these three objectives for the period of 1933 to 1968. Their results suggest that during the 1933-1939 period the Fed was concerned with its stabilization and financial stability objectives. From 1940 through 1952, Fed policy was dominated by the even-keel objective, probably due to war debt financing by the treasury. Finally, from 1953 through 1968, monetary policy was most responsive to financial stability and overall stabilization.

As part of a larger study, Ronald Teigen [44] developed a monetary policy reaction function for the period 1953 through 1964. Teigen tested the relationship between the sum of unborrowed reserves and currency (the monetary indicator) and proxies of employment, prices, growth, and balance of payments (the goals of policy). The data were in the form of percentage changes. Teigen concludes that the Fed was responsive to income, the balance of payments (as measured by the short-term treasury bill rate), and to a lesser extent unemployment, but, surprisingly, monetary policy reacted very little to growth in output or inflation during this period.

Ann Friedlaender [14] attempted to apply revealed preferences to the activities of the federal government to determine the weights attached to various macro policy goals for the period 1954 to 1964. The purpose was to see if the weights changed from the Eisenhower years to the Kennedy-Johnson years. Federal Reserve policy was just one of four federal policy instruments analyzed. Friedlaender used net free reserves as the monetary indicator and a dummy variable to test for a change in policy for the two political administrations. Her results suggest that the monetary authorities reacted to the price level and output objectives during the Eisenhower administration. During the Kennedy-Johnson years, the Fed responded to the price level and, to a lesser extent, short-term interest rate stability.

Richard Froyen [16] developed a monetary policy reaction function which contained a feature that distinguished his study from previous attempts. Froyen used monthly data to remove the potential for reverse causation. He also noted that monthly data conforms more closely with Federal Reserve policy periods because the FOMC meets once a month. For monetary indicators, Froyen used the monetary base and the sum of unborrowed reserves plus currency held by the public. The objectives of monetary policy tested were one month lagged values of unemployment, inflation, balance of payments surplus, total sales and the two financial objectives of stable long-term interest rates (proxy for overall financial stability), and outstanding debt (proxy for the "making a market" objective). Froyen broke his study intro three subperiods. During the first period of 1953 through 1960, Froyen concluded that the monetary authorities reacted to the unemployment rate and total sales. From 1961 through 1968, the Fed responded to unemployment, inflation, total sales, the public debt, and financial stability objectives. During the final period of 1969 through 1972, the Fed reacted to unemployment, total sales, balance of payments, and financial stability. It is noteworthy that in all three periods both unemployment and total sales had significant effects on monetary policy. With respect to the total sales objective, it would appear the Fed usually accommodated increases in the transactions demand for money.

To test the Federal Reserve's response to the state of the economy, Havrilesky, Sapp, and Schweitzer [21] developed a monetary policy reaction function for the period 1964-1974. The indicator chosen was the federal funds rate, which has since been used by many researchers. The objectives of monetary policy were assumed to be one month lagged values of the unemployment rate, price level, money supply, and international financial position (represented by the dollar/Deutsche mark exchange rate). They grouped monthly data into periods of "tight money" and "easy money." During tight money periods, it appears the Fed reacted to the price level and the exchange rate. During easy money periods, they conclude that the Fed responded to unemployment and exchange rates in the hypothesized manner, but in some instances the Fed responded to the price level in a perverse manner.

Paul DeRosa and Gary Stern [10] developed a monetary policy reaction function for the purpose of detecting the supposed shift by the Fed in early 1970 toward a monetary aggregate strategy. To accomplish this, they compared the coefficients of a reaction function estimated for the 1967 through 1969 period to those estimated for the 1970 through 1974 period. DeRosa and Stern used the federal funds rate as the monetary indicator and tested the effect of lagged values of both the federal funds rate and the money supply on this indicator. From 1967 through 1969, the lagged value of the federal funds rate was significant, but from 1970 through 1974 the lagged money supply was a significant determinant of policy. Thus, DeRosa and Stern concluded that the shift in policy strategy was detectable although their results suggest that the Fed did react cautiously to changes in the money supply from 1970 through 1974.

In a very similar study, Chase Econometrics [8] created a reaction function for the same purpose as the DeRosa-Stern paper; that is, to discover if the Fed has reacted more noticeably to monetary aggregates since 1970. Using the federal funds rate for the monetary indicator, and lagged changes in money, unemployment, and prices for the objectives of montary policy, their results indicate that the Fed did in fact react to monetary aggregates in the 1970-1978 period. During the period 1966 to 1970, the Fed did not respond to changes in the money supply, but it did react to changes in unemployment.

Glenn Potts and Dudley Luckett [38] developed a monetary policy reaction function to discover whether presidential administrations are a meaningful way to classify Federal Reserve response to the goals of employment, growth, price stability, and balance of payments equilibrium. Their choice of a monetary indicator is most interesting. They classified monetary policy into "tight" or "easy" periods directly from their reading of the minutes of the FOMC monthly meetings. This eliminates many of the problems associated with the monetary indicators previously discussed. Using discriminant analysis on monthly data from 1956 through 1975, Potts and Luckett concluded that during the Eisenhower administration the Fed was most concerned with the objectives of stable prices and growth. The Kennedy-Johnson period was dominated by concern with unemployment and growth, and by a lesser extent stable prices. During the Nixon-Ford era, the Fed was concerned with unemployment, and to a lesser degree growth, and, surprisingly, the Fed apparently did not respond to the objective of stable prices. The balance of payments objective was not a significant determinant of monetary policy during any period studied. In a related study, Luckett and Potts [29] again used discriminant analysis, this time to test Tufte's [45] thesis, which has implied that the Fed is a tool for partisan politics. That is, the Fed is expansionary prior to a presidential election, and contractionary after the election. Luckett and Potts grouped the data into the period two years prior to an election and the two years after the election for the Kennedy-Johnson and Nixon-Ford years. Their results do not indicate that the Fed was more concerned with employment and growth in the preelection periods, nor more concerned with inflation in the postelection periods.

As Luckett and Potts had done, Robert Avery [6] developed a monetary policy reaction function with an innovative policy indicator. His monetary indicator was a vector containing borrowing by member banks from the Fed, net free reserves, the federal funds rate, call rates of government bond dealers, the three-month treasury bill rate, and the discount rate. He tested the response of this indicator to changes in unemployment, growth, prices, and international equilibrium for the period 1955 to 1975. All goal variables significantly affected monetary policy. Most noteworthy, the balance of payments proxy was significant, a result few researchers have obtained.

Basil Moore [32] created a monetary policy reaction function to test the influence of the money wage rate on the monetary base. Moore's thesis is that the money supply is endogenous due to pressure from the financial markets to accommodate changes in the money wage rate. If this hypothesis is not rejected, doubt would be cast on the monetarist view that the money supply is the single most important determinant of nominal income. Moore suggests that excessive wage demands (exceeding the growth in labor productivity) cause increased demand for credit. If the central bank does not accommodate the increased credit demand, the financial markets will become unstable resulting in rising unemployment. If they do accommodate the increased credit demand, the price level and nominal income will rise. Moore's statistical results for the period 1951 to 1977 suggest that the money wage rate has a highly significant influence on movements in the monetary base.

Richard Abrams, Richard Froyen, and Rodger Waud [1] studied the period when Arthur Burns was the chairman of the Federal Reserve--1970 through 1977. They tested the reaction of the federal funds rate to "predicted"[1] values of unemployment, inflation, the money supply, and

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[1]Abrams, Froyen, and Waud [1] used various econometric methods to derive data that the Fed could have known at the time it made each policy decision. Some variables were forward forecasts. For discussion of the forecasting methods, see [1, pp. 35-37].

dollar devaluation. All coefficients were found to be significant. In particular, because the money supply was significant, they concluded that the Fed did respond to monetary aggregates which many observers had doubted. In addition, they found no evidence of reaction function coefficient instability. This suggests that the Fed reacts to economic conditions systematically.

James Barth, Robin Sickles, and Philip Weist [7] employed a generalized spline estimator technique to a Federal Reserve reaction function which allowed the marginal response by the Fed to economic conditions to vary according to the severity of these conditions. For example, one might expect the monetary authorities to react differently to a one percent rise in inflation when inflation is seven percent rather than four percent. They utilized the monetary base as the indicator of policy, and inflation, unemployment, changes in short-term interest rates, total sales, and the full employment budget surplus as the objectives of policy for the period 1953 to 1978. Their results indicate that the Fed was most responsive to inflation when it was unusually high, but surprisingly the Fed responded less systematically to unemployment.

For the purpose of testing political influence on monetary policy, Myles Wallace and John Warner [49] developed a monetary policy reaction function. They chose the monetary base, federal funds rate, free reserves, and a dichotomous variable of "tight" and "easy" money for the policy indicators. The independent variables adopted were the standard objectives of monetary policy plus a dummy variable for one year and two years preceding a presidential election. They conclude that during the period 1956 to 1980, only the Nixon administration, and to a lesser extent the Johnson and Eisenhower administrations, were associated with expansion prior to an election.[1]

Leroy Laney and Thomas Willett [27] developed a Federal Reserve reaction function to test whether the election cycle has influenced the behavior of the money supply. They tested for two separate mechanisms through which the presidential electoral cycle could affect monetary expansion--direct (Fed catering to party in power) and indirect (partisan politics affecting variables to which the Fed responds such as wage demands and government deficits). Using annual data for the 1960-1976 period, Laney and Willett concluded that the money supply was unaffected directly by the election cycle. However, their evidence suggests that the Fed does react indirectly to the election cycle through the election-induced deficit component of the federal deficit.

Finally, with the purpose of testing the impact of fiscal variables (real government expenditures and the real deficit) on the money supply, Stuart Allen and Michael Smith [3] created a monetary reaction function for the 1961 through 1980 period. Using quarterly data, they regressed current and lagged values of the change in the money supply, real government expenditures, and outstanding federal debt on the monetary base. They concluded that the federal debt had a positive and significant influence on money creation. In addition, they rejected the hypothesis

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[1]This paper was not included in Table 2.1b because only the significance of the dummy variables were reported. It is included here because political effects on monetary policy are tested in this dissertation.

of coefficient stability in this reaction function for the period studied.

In light of these past studies, it should be clear that researchers have related many monetary indicators to many objectives of monetary policy. However, it may not be clear that the necessity to use so many "goals" or "objectives" of monetary policy may be due to specification error of the indicator. For example, many studies have used the deficit and money wage rates to "sort out" accommodative monetary policy so as to better analyze monetary policy intent. This may be necessary when using monetary aggregates or the monetary base as an indicator of policy, but it is unnecessary when using a dichotomous variable of "tight money" versus "easy money" obtained directly from analyzing the Record of Policy Actions of the Federal Open Market Committee as the indicator of monetary policy intent. In addition, the use of money market indicators of policy (federal funds rate, three-month treasury bill rate, etc.) also requires the addition of independent variables in the model to remove exogenous market effects from movements in the indicator.

Finally, only in the Abrams, Froyen, and Waud [1] paper were methods used to "forecast" data such that the model allowed the monetary authorities to react to information that they would likely have known at the time they made their policy decisions. In addition, this allowed for the possibility that the Fed reacts to expectations of future values of the objectives of monetary policy.

For these reasons, I will develop a model of Federal Reserve reaction to the objectives of monetary policy in the following chapter.

It is a dichotomous qualitative response model with independent variables which are forecasts of the objectives of monetary policy.

Table 2.1a. Glossary of symbols and notes for Table 2.1b

Glossary of Symbols:

U = Unemployment
P = Inflation rate or the absolute change in price index
BPS = Balance of payments surplus
Y/P = Real income (or proxy for production)
Y = Nominal income
TS = Total sales (business sales)
XR = Exchange rate
D = Outstanding U.S. government debt in hands of public
r = Short term interest rate, T-bill rate, Federal funds rate
FES = Full employment federal government budget surplus
M = Monetary aggregate (many)
Gap = Difference between desired and actual output (Y_d - Y_a)
FR = Free reserves
W = Money wage rate
ED = Election dummy
HED = High employment deficit
EID = Election induced deficit
G = Real government expenditure

Notes:

(+) means positive significant coefficient, (-) means negative significant coefficient at the 5 percent level or better
(0) means insignificant coefficient at 5 percent level
A represents annual data
Q represents quarterly data
M represents monthly data

Table 2.1b. Summary of previous estimates of monetary policy reaction functions

Study	Method of test	Time period	Dependent variable
Dewald & Johnson [11]	Multiple regression	1952 I 1961 IV	Money supply
	Multiple regression	1952 I 1961 IV	T-bill rate
	Multiple regression	1952 I 1961 IV	T-bond rate
	Multiple regression	1952 I 1961 IV	Free reserves
Goldfeld [18]	Multiple regression	1950 III 1962 II	Potential demand deposits
Havrilesky [20]	Multiple regression	1952 II 1965 IV	"Adjusted" total reserves
Wood [51]	Two-stage least squares	1952 I 1963 IV	Fed holdings of gov't securities
Christian [9]	Multiple regression	1952 I 1966 IV	Money supply
	Multiple regression	1952 I 1966 IV	Free reserves
	Multiple regression	1952 I 1966 IV	Treasury bill rate
Keran & Babb [25]	Multiple regression	1933 III 1939 IV	Monetary base
	Multiple regression	1940 I 1952 IV	Monetary base
	Multiple regression	1953 I 1968 IV	Monetary base
Teigen [44]	Multiple regression	1953 I 1964 IV	Unborrowed reserves plus currency
Friedlaender [14]	Multiple regression	1954 I 1960 IV	Net free reserves
	Multiple regression	1961 I 1964 IV	Net free reserves

[a] Teigen used an income proxy for sensitivity to unemployment.

[b] The sensitivity to 'r' was interpreted as sensitivity to potential international capital flows.

Form of data	Data Frequency	U	P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W
level	Q	+	0	0	+										
level	Q	−	+	−	−										
level	Q	−	+	0	0										
level	Q	+	0	+	+										
level	Q	+	0	0		+									
level	Q	+	−	0		+									
change	Q	0	−	+		−									
change	Q	+	−	+	+										
change	Q	0	−	0									+		
change	Q	0	+	0									−		
change	Q								−	0				+	
change	Q								+	0				0	
change	Q								0	+				+	
percent change	Q	+[a]	0			+				+[b]			0		
level	Q	0	+	0						0			+		
level	Q	0	−	0						−			0		

P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W	ED	HED	EID	G
0	0	+														
+	-	-														
+	0	0														
0	+	+														
0	0		+													
-	0		+													
-	+		-													
-	+	+														
-	0									+						
+	0									-						
						-	0				+					
						+	0				0					
						0	+				+					
0			+				+[b]			0						
+	0						0			+						
-	0						-			0						

Table 2.1b. Continued

Study	Method of test	Time period	Dependent variable
Froyen [16]	Multiple regression	1953: 2 1961: 1	Monetary base
	Multiple regression	1961: 2 1969: 1	Monetary base
	Multiple regression	1969: 2 1972: 12	Monetary base
Havrilesky, Sapp, and Schweitzer [21]		Tight money	
	Multiple regression	1964: 1 1966: 11	Federal funds rate
	Multiple regression	1967: 12 1968: 6 & 1969: 1 1970: 1	Federal funds rate
	Multiple regression	1971: 8 1972: 9	Federal funds rate
		Easy money	
	Multiple regression	1966: 12 1967: 11 & 1968: 7 1968: 12	Federal funds rate
	Multiple regression	1970: 2 1971: 7	Federal funds rate
	Multiple regression	1972: 9 1974: 2	Federal funds rate
DeRosa & Stern [10]	Multiple regression	1967: 3 1969: 12	Federal funds rate
	Multiple regression	1970: 12 1974: 12	Federal funds rate
Chase Econometrics [8]	Multiple regression	1966: 1 1970: 2	Federal funds rate
		1970: 3 1978: 1	Federal funds rate

Form of data	Data Frequency	U	P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W	E
level	M	+	0	0			+		0	0	0					
level	M	+	−	0			+		+	0	−					
level	M	+	0	+			+		+	0	0					
level	M	0	+					+								
level	M	0	+					0				0				
level	M	0	+					−				0				
level	M	−	+					0				0				
level	M	−	−					+				0				
level	M	−	+					+				0				
percent change	M						0			+		0				
percent change	M						+			0		+				
change	M	−	0									0				
change	M	−	+									+				

P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W	ED	HED	EID	G
0	0			+		0	0	0								
-	0			+		+	0	-								
0	+			+		+	0	0								
+					+											
+					0				0							
+					-				0							
+					0				0							
-					+				0							
+					+				0							
				0			+		0							
				+			0		+							
0									0							
+									+							

Table 2.1b. Continued

Study	Method of test	Time period	Dependent variable
Potts & Luckett [38]	Discriminant analysis	1956: 1 1975: 12	Tight money vs easy money
	Discriminant analysis	1956: 1 1961: 1	Tight money vs easy money
	Discriminant analysis	1961: 2 1969: 1	Tight money vs easy money
	Discriminant analysis	1969: 2 1975: 12	Tight money vs easy money
Avery [6]	Multiple regression	1955: 1 1975: 4	"Unobserved variable"[d]
Moore [32]	Multiple regression	1951: 6 1977: 6	Monetary base
	Multiple regression	1951: II 1977 II	Monetary base
Abrams, Froyen and Waud [1]	Three-pass least squares	1970: 3 1977: 3	Federal funds rate
Luckett & Potts [29]	Discriminant analysis	1963: 1- 1964: 11 & 1967: 1- 1963: 11	Tight money vs easy money
	Discriminant analysis	1961: 2- 1962: 12 & 1965: 2- 1966: 12	Tight money vs easy money
	Discriminant analysis	1971: 1- 1972: 11 & 1975: 1- 1976: 11	Tight money vs easy money
	Discriminant analysis	1969: 2- 1970: 12 & 1973: 2- 1974: 12	Tight money vs easy money

[c]Significant at the 10 percent level with expected signs.

[d]The monetary indicator is a vector of six instruments and intermediate targets, therefore its direction can not be established with respect to tight money or easy money. Avery suggests that a positive change in this indicator is contractionary.

Form of data	Data Frequency	U	P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W	E[illegible]
change & level	M	−	0	0	+											
change & level	M	0	+	0	+											
change & level	M	−	$+^c$	0	+											
change & level	M	−	0	0	$+^c$											
change	M	−	+	−	+											
logs	M	−	+					+		−					+	
logs	Q	−	+					+		−					+	
level	M	−	+					+		+		+				
change & level	M	+	0		0											
change & level	M	−	0		$+^c$											
change & level	M	−	0		0											
change & level	M	−	0		+											

P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W	ED	HED	EID	G
0	0	+														
+	0	+														
$+^c$	0	+														
0	0	$+^c$														
+	–	+														
+					+		–					+				
+					+		–					+				
+					+		+		+							
0		0														
0		$+^c$														
0		0														
0		+														

Table 2.1b. Continued

Study	Method of test	Time period	Dependent variable
Barth, Sickles, & Weist [7]	Generalized spline estimator	1953: 1 1978: 2	Monetary base
Laney and Willett [27]	Multiple regression	1960-1976	Money supply
	Multiple regression	1960-1976	Money supply
Allen & Smith [3]	Multiple regression	1961 III 1980 IV	Monetary base

[e]Laney and Willett defined "Gap" as the difference between actual and potential output ($Y_a - Y_p$).

Form of data	Data Frequency	U	P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W	E
level	M	+	−				+			0	−					
level & change	A		−		+							+	$-^{e}$		+	0
level & change	A		−		+							+	$-^{e}$		+	
logs	Q								+			+				

U	P	BPS	Y/P	Y	TS	XR	D	r	FES	M	Gap	FR	W	ED	HED	EID	G
+	-				+			0	-								
	-		+							+	-[e]		+	0	+		
	-		+							+	-[e]		+		+	+	
							+			+							-

CHAPTER III. SPECIFICATION OF THE MODEL

This chapter is organized as follows: the first section develops a theoretical model of Federal Reserve policy adoption and the econometric reaction function used to estimate the coefficients in this model; the second section presents the method of data generation of the independent variables employed in the reaction function; and the third section presents a discussion of the policy indicator which is the dependent variable in the reaction function.

A Model of Federal Reserve Policy Adoption

The Federal Reserve faces outcomes from the adoption of a monetary policy that are uncertain. In this model, the Fed is assumed to adopt an easy money policy or a tight money policy based upon an objective of utility maximization. Denote a policy index p where p=1 for a tight money policy, and p=2 for an easy money policy, and denote a utility function $U(G_{pi})$ that ranks the Fed's preference for policy during the i-th time period.[1] Utility depends on a vector G_p of moments that describe the goals of policy. The variables in G_{pi} are unobserved, but a linear relationship is postulated for the i-th time period between the utility derived from the p-th policy and a vector of observed (or forecast) time period specific economic conditions X_i (e.g., growth in

[1]This utility function can be viewed as if the Fed is a single decision making unit. Alternatively, this utility function could be that of the median voter on the Federal Open Market Committee. This second approach more closely aligns with the method of policy classification found in Potts [37].

output, inflation, unemployment, and international balance) and a zero mean random disturbance term e_p:

$$U_{pi} = X_i\alpha_p + e_{pi}, \quad p = 1,\ 2;\ i = 1 \ldots n. \tag{3.1}$$

The Fed is assumed to choose the policy that gives them the largest utility. For example, the Fed will adopt or continue an easy money policy if U_{2i} exceeds U_{1i}, and the dichotomous qualitative variable D_i indexes this policy decision:

$$D_i = \begin{cases} 1 \text{ if } U_{1i} < U_{2i}, \text{ adopt or continue easy money policy.} \\ 0 \text{ if } U_{1i} > U_{2i}, \text{ adopt or continue tight money policy.}^{1} \end{cases} \tag{3.2}$$

The probability that D_i equals one can be expressed as a function of time period specific economic conditions:

$$\begin{aligned} P_i &= P_r(D_i{=}1) = P_r(U_{1i} < U_{2i}), \\ &= P_r(X_i\alpha_1 + e_{1i} < X_i\alpha_2 + e_{2i}), \\ &= P_r[e_{1i} - e_{2i} < X_i(\alpha_2 - \alpha_1)], \\ &= P_r(u_i < X_i\beta) = F(X_i\beta) \end{aligned} \tag{3.3}$$

where $P_r(\bullet)$ = a probability statement,

$u_i = e_{1i} - e_{2i}$ = a new random disturbance term,

---

[1]There is indecision of $U_{2i} = U_{1i}$, but this happens with zero probability if e_{2i} and e_{1i} are continuous random variables. See Amemiya [4].

$\beta = \alpha_2 - \alpha_1$ = a new coefficient vector, and

$F(X_i\beta)$ = the cumulative distribution function for u_i evaluated at $X_i\beta$.

Thus, the probability of the Fed adopting an easy money policy is the probability that the utility to the Fed generated by a tight money policy is exceeded by the utility generated by an easy money policy, or the cumulative distribution function F evaluated at $X_i\beta$. The exact distribution for F depends on the distribution of the random disturbance term $u_i = e_{1i} - e_{2i}$. If the distribution of u_i is uniform, then F is triangular and the model is specified as a linear probability model; if the distribution of u_i is normal, then F is a cumulative normal and the model is specified as a probit probability model.

The marginal effect of a variable X_j, j=1 ... k and k = the number of independent variables in X, on the probability of adopting an easy money policy is $\partial P_i/\partial X_{ij} = f(X_i\beta) \cdot \beta_j$ where $f(\cdot)$ is the probability density function of u_i. The direction of the marginal effect is determined by the sign of β_j, but β_j represents coefficient differences $\alpha_{2j} - \alpha_{1j}$. Thus, β_j is expected to be positive (negative, zero) if α_{2i} is positive and greater than (less than, equal to) α_{1j}.[1]

The preceding model can be estimated with the reaction function:

$$Y = X\beta + v \tag{3.4}$$

[1]This model is a transformation of a model described by Amemiya [4] and used by Rahm and Huffman [40].

where Y = an nx1 column vector of D_i,

X = an nxk matrix of k explanatory variables for n periods,

β = a kx1 column vector of estimated coefficients, and

v = an nx1 column vector of error terms.

This model will be estimated using ordinary least squares for a linear probability model[1] and a maximum likelihood probit procedure for a probit probability model.[2]

To better explain the elements of the X matrix, the reaction function can be expressed in scalar form:

$$D_i = b_0 + b_1\hat{GO}_i + b_2\hat{I}_i + b_3\hat{U}_i + b_4\hat{IB}_i + v_i \qquad (3.5)$$

where GO_i, I_i, U_i, and IB_i represent the independent variables of the X matrix and:

GO_i = growth in output,

I_i = rate of inflation,

U_i = unemployment,

IB_i = international balance, and

v_i = error term.

The superscript ($\hat{}$) denotes forecasts of a variable, to be explained presently.

---

[1]There is heteroscedasticity in a linear probability model if it is estimated with ordinary least squares. This produces unbiased coefficients that are not minimum variance. If this is corrected with generalized least squares, the coefficients will be minimum variance, but they will now be biased. For a further discussion of heteroscedasticity in a linear probability model, see Ladd [26].

[2]This procedure is developed in Pindyck and Rubinfeld [35], p. 310.

The Independent Variables in the Reaction Function

At the time they make the policy decisions, the members of the Federal Open Market Committee do not know the current values of the economic goals of monetary policy. It is, therefore, plausible that they base their decisions on forecasts of these goal variables. For this reason, the reaction function will be estimated using the "predicted" values of these goal variables from an unrestricted vector autoregression of the following specification.

Assume that growth (z_1), inflation (z_2), unemployment (z_3), and international balance (z_4) are jointly determined as part of an m-variable ($m \geq 4$) vector stochastic process which can be approximated by the r-th order vector autoregression:

$$Z(t) = A(1)Z(t-1) + A(2)Z(t-2) + \ldots + A(r)Z(t-r) + W(t) \quad (3.6)$$

where Z(t) is an mx1 vector of variables (which includes $z_1(t) \ldots z_4(t)$; A(j), j=1 ... r, are mxm matrices of the time-invariant coefficients; and W(t) is an mx1 vector of disturbances; note: m = number of variables in the vector and r = number of periods lagged. The Z(t) process is assumed to be stationary.

Each of the m equations in equation (3.6) can be estimated by ordinary least squares.[1] This may be understood more clearly if equation

[1]For a proof of the consistency of OLS and of the equivalence of OLS and GLS under these conditions, see Anderson and Taylor [5], cited by [12, p. 113].

(3.6) is expressed in scalar form for the two variables (m=2), two period lag (r=2) case:

$$z_{1t} = a_{11,1}\, z_{1,t-1} + a_{12,1}\, z_{2,t-1} + a_{11,2}\, z_{1,t-2} + a_{12,2}\, z_{2,t-2} + w_{1t}, \tag{3.7}$$

$$z_{2t} = a_{21,1}\, z_{1,t-1} + a_{22,1}\, z_{2,t-1} + a_{21,2}\, z_{1,t-2} + a_{22,2}\, z_{2,t-2} + w_{2t} \tag{3.8}$$

where the coefficient subscripts are (in order):

1st--dependent variable,

2nd--endogenous variable, and

3rd--periods lagged.

In matrix form, showing explicitly the elements of the matrices:

$$\begin{bmatrix} z_{1t} \\ z_{2t} \end{bmatrix} = \begin{bmatrix} a_{11,1} & a_{12,1} \\ a_{21,1} & a_{22,1} \end{bmatrix} \begin{bmatrix} z_{1,t-1} \\ z_{2,t-1} \end{bmatrix} + \begin{bmatrix} a_{11,2} & a_{12,2} \\ a_{21,2} & a_{22,2} \end{bmatrix} \begin{bmatrix} z_{1,t-2} \\ z_{2,t-2} \end{bmatrix} + \begin{bmatrix} w_{1t} \\ w_{2t} \end{bmatrix}. \tag{3.9}$$

Forecasts of the monthly values of the objectives of monetary policy will be generated using the estimated coefficient from this VAR model. In utilizing data which has been forecast from an unrestricted VAR model, it has been assumed that the Fed has "consistent" or "partly rational" expectations [31, pp. 50-51].

It is important to note a few points about this forecasting method. It has not been assumed that the Fed actually forecasts the goal variables in the manner described. It has been assumed that the data set used in this study consistently reflects the information the Fed has available for policy decisions. Specifically, the data set used may include fewer variables than the Fed's actual data set. It is, therefore, necessary to assume that any additional data the Fed uses for forecasting is uncorrelated with the data set used in this study. This will allow for the reaction function coefficients to be consistent estimates of the true parameters in the model. It should be noted, however, that the parameter estimates will be less efficient the greater the Fed's forecasts differ from the forecasts developed in this study. This difference is not measurable because the Fed's actual forecasts cannot be obtained.

The Policy Indicator

As previously stated, this study is concerned with the intent of monetary policy. It would be improper to use money market variables or monetary aggregates as the indicators of policy because these indicators may measure actual policy, not intended policy.

Monetary policy intent was classified as "tight" or "easy" by an evaluation of the monthly Record of Policy Actions of the Federal Open Market Committee published in the Annual Report of the Board of Governors. This series was created by Glenn Potts [37] for the period 1956 through 1975 and was extended by Wallace and Warner [49] to include

1953 through 1955 and 1976 through 1984.[1] These data were transformed for use as the dependent variable in equations 3.4 or 3.5.[2]

Although this type of policy indicator avoids the problems associated with the money market or monetary aggregate indicators, it does raise problems of its own. The obvious problem is subjectivity in the classification of a continuous variable (monetary policy) into a binary classification of "tight money" and "easy money." In defense of this classification, it should be noted that independent evaluations of the Record of Policy Actions of the FOMC are nearly identical.[3]

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[1]The series created by Potts was published in his dissertation, while the extensions of this series created by Wallace and Warner were obtained by request.

[2]Tight money periods were represented by "0" and easy money periods were represented by "1."

[3]This method of classification has been employed independently by William Poole [36], Glenn Potts [37], and Wallace and Warner [49]. The only disagreement seems to be 1961(11)-1963(6). For a discussion of this period of disagreement and the method of classification, see Potts [37, pp. 16-21].

CHAPTER IV. DATA, RESULTS, AND DISCUSSION FOR THE FULL SAMPLE PERIOD REACTION FUNCTIONS--1953(2) THROUGH 1984(4)

The timespan for this portion of the study is February 1953 through April 1984. Although data prior to 1953 were available, they were not used because there is some doubt as to the independence of Federal Reserve decision making prior to the Federal Reserve-Treasury Accord.

The sample period is divided into subperiods according to two schemes. First, the data are grouped into three subperiods corresponding to the tenure of the different chairmen of the Board of Governors. Second, the data are divided into two subperiods: the two-year periods that precede presidential elections and the two-year periods that follow presidential elections.

The Data

Monthly values of personal income, the industrial production index, the producer price index, the consumer price index, the unemployment rate, the balance of trade surplus,[1] the M1 money supply, and the three-month Treasury bill rate were obtained from various issues of <u>Business Statistics</u> and <u>Survey of Current Business</u>. This list of variables includes the goal or target variables to be used in the reaction function plus additional variables thought to affect the target variables in future periods.

[1]The balance of trade surplus was calculated by differencing the monthly value of exports and general imports. This series was used because balance of trade and balance of payments data are quarterly series. Although available on a monthly basis, exchange rate data were not used because of the existence of fixed exchange rates prior to 1973.

All data series must be stationary for use in a vector autoregression. To accomplish this, the following transformations were made on the original data:

Target variables:

1) personal income (PI)--first difference of the log of the levels,
2) industrial production index (IP)--first difference of the log of the levels,
3) producer price index (PPI)--first difference of the log of the levels,
4) consumer price index (CPI)--second difference of the log of the levels,
5) unemployment (U)--first difference of the levels, and
6) balance of trade surplus (BT)--first difference of the levels divided by personal income.

Additional variables:

7) three-month Treasury bill rate (TI)--first difference of the log of the levels, and
8) money supply (M)--second difference of the log of the levels.

After the transformation, personal income, the industrial production index, the producer price index, and the three-month Treasury bill rate are in the form of growth rates.[1] The consumer price index and the money supply are in the form of a change in the growth rate. Unemployment is simply the change in the unemployment rate, while the balance of trade surplus is the change in the balance of trade as a proportion of personal income. The transformed data were utilized in a vector autoregression (VAR) model of the form of equation 3.6, which can be found on page 33. A sixth-order VAR model was chosen to "forecast" the potential target variables.[2] Of these target variables, only the forecast of the CPI was in a form not desired for final use in the reaction function. Consequently, the forecast of the change in the growth rate of the CPI was converted into the growth rate of the CPI.

One should note that these forecasts are not true forward forecasts. The forecasts are the predicted values of the variables in the VAR. Therefore, this method can be criticized on two grounds. First, data from the full sample period were used to generate the forecasting coefficients. Therefore, information was used to generate these forecasts that was not available to the monetary authorities at the time they made their

---

[1]The growth rate of $x(t) = g_x$:

$$g_x = \frac{dx(t)}{dt} \cdot \frac{1}{x(t)} = \frac{d\ \ln[x(t)]}{dt},$$

$$g_x \approx \ln x(t) - \ln x(t-1).$$

[2]A system log likelihood test was performed on the VAR model to test the significance of additional restrictions; these restrictions were the use of fewer lags than six in the system. Starting with six lags on each variable, the restriction of one lag fewer was tested from six lags through three lags. The sixth lag was significant at the ten percent level, while all others were significant at the five percent or one percent level. For this reason, a symmetric lag structure of six periods was employed.

forecasts. Second, the coefficients may not be time invariant. However, if the various time series exhibit the property of ergodicity, these problems do not exist and the predicted values are the same as forecasts.[1]

Table 4.1 shows the correlation between the predicted and actual values of the target variables. Although this correlation is relevant in determining the quality of the forecasts, it does not provide information about how closely these forecasts correlate with the Fed's actual forecasts because the Fed's actual forecasts cannot be obtained.

Table 4.1. Correlation between actual and predicted values of the target variables generated from a fixed-coefficient VAR model: 1953(2)-1984(4)

Target variable	Correlation
1. Personal income ($\widehat{PI}$)	.51
2. Industrial production index ($\widehat{IP}$)	.62
3. Producer price index ($\widehat{PPI}$)	.57
4. Consumer price index ($\widehat{CPI}$)[a]	.62
5. Unemployment ($\hat{U}$)	.65
6. Balance of trade ($\widehat{BT}$)	.65

[a]Correlation of second differences of the logs of the levels.

[1]There is no test for the existence of ergodicity in a time series, therefore none was performed. For an explanation of an ergodic time series, see Fuller [17, p. 230].

The Reaction Function

The target variables can be placed into the four categories of the objectives of monetary policy:

1) growth in output--$\hat{PI}$ or $\hat{IP}$,

2) price stability--$C\hat{P}I$ or $P\hat{P}I$,

3) unemployment--$\hat{U}$, and

4) international balance--$\hat{BT}$.

Two output and two price variables can be combined into four combinations. For this reason, four different reaction functions were estimated for each subperiod studied. However, to avoid the reporting of redundant results, only one form of the reaction function is reported in this chapter. It is of the following form:

$$P_t = c_0 + c_1\hat{IP}_t + c_2P\hat{P}I_t + c_3\hat{U}_t + c_4\hat{BT}_t + \varepsilon_t \qquad (4.1)$$

where P = policy indicator, 0 = tight money, 1 = easy money;

$\hat{IP}$ = predicted value of the growth rate of the industrial production index;

$P\hat{P}I$ = predicted value of the growth rate of the producer price index;

$\hat{U}$ = predicted value of the change in unemployment percentage;

$\hat{BT}$ = predicted value of the change in the balance of trade as a proportion of personal income;

ε = error term.

The industrial production index was chosen as the proxy for growth in output because it is a real variable. Furthermore, personal income was not used because it is a nominal variable which tends to be highly correlated with the price variables. The choice of the PPI over the CPI was somewhat arbitrary. Reaction functions fitted with the PPI tended to out perform those fitted with the CPI, but in most periods the results were not sensitive to the choice of an inflation proxy.[1]

If the Fed does base its policy decisions on the objectives in equation 4.1, the following relationships should exist:

1) high economic growth is associated with a tight money policy ($c_1 < 0$), ceteris paribus,
2) rising prices are associated with a tight money policy ($c_2 < 0$), ceteris paribus,
3) rising unemployment is associated with an easy money policy ($c_3 > 0$), ceteris paribus, and
4) a rising balance of payments surplus is associated with an easy money policy ($c_4 > 0$), ceteris paribus.

Results of Subperiods Classified by Chairmen of the Board of Governors

Equation 4.1 was estimated as a linear probability model and as a probit probability model for the three subperiods that correspond with the chairmanships of William McChesney Martin, Jr. (1953(2)-1970(1)),

[1]Alternative lag structures of one and two periods in either direction from the policy indicator were also tested. The results were not significantly different, therefore the reaction function was estimated with forecasts of concurrent target variables.

Arthur F. Burns (1970(2)-1978(1)), and Paul A. Volcker (1979(9)-1984(4)).[1] Analysis of these three periods will provide inferences as to the objectives of monetary policy during each chairman's tenure. Also, this analysis will provide a framework to discuss differences among priority systems used during the different chairmanships.

The Martin years, February 1953-January 1970

Table 4.2 presents the results of ordinary least squares and probit estimates of the reaction function for the Martin years. The F-ratio and the χ^2 value are both significant at the one percent level. This suggests that the policy-adoption decision of tight money or easy money is influenced by the policy objectives in the reaction function. The estimated coefficients of unemployment and the producer price index are also highly significant and carry the expected sign. The beta coefficient of the producer price index is similar in size to that of unemployment, suggesting that the Fed may have been nearly equally concerned with the price level and unemployment.[2] Apparently, growth and the balance of trade were not influential factors in the policy adoption decisions during Martin's tenure.

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[1]G. William Miller's chairmanship was excluded because his tenure only lasted approximately 19 months. In addition, the results of the reaction function estimation for this period were insignificant.

[2]Beta coefficients (sometimes called standardized or normalized coefficients) can be used directly to make statements about the relative importance of the independent variables in a multiple regression model. They are formed by performing an OLS on variables where each variable is normalized by subtracting its mean and dividing by its estimated standard deviation. The beta coefficients reported in this study should be interpreted with caution, however, because the linear reaction function is heteroscedastic. See Ladd [26].

Table 4.2. Results of the Martin years, 1953(2)-1970(1)

	Probability model				
	Linear[a]			Probit[b]	
Independent variable	Beta coefficient	Estimated coefficient[c]	t-ratio	Estimated coefficient	t-ratio
Intercept	-	0.49105	-	-0.026277	-
$\hat{IP}$	0.027239	2.0210	0.288	7.9711	0.380
$\hat{PPI}$	-0.29619	-59.315***	-4.494	-171.02***	-4.229
$\hat{U}$	0.25183	0.86714***	2.646	2.5439**	2.544
$\hat{BT}$	0.0078069	0.014121	0.121	0.037656	0.108

[a] $n = 204$, $R^2 = .17$, $F = 10.288$***.

[b] $n = 204$, log likelihood = -120.48, chi-square = 37.217***.

[c] *, **, and *** appearing in Tables 4.2, 4.3, 4.4, 4.5, and 4.6 indicate significance at the 10, 5, and 1 percent levels, respectively. t-tests are two-tailed while F and χ^2 tests are one-tailed.

The Burns years, February 1970-January 1978

Table 4.3 presents the results of ordinary least squares and probit estimates of the reaction function for the Burns years. The results are strikingly different from the other periods estimated. Neither the F-ratio nor the χ^2 value are significant at the ten percent level; consequently, the hypothesis that all slope coefficients equal zero cannot be rejected. Furthermore, the R^2 is low suggesting that very little of the variance in the policy indicator is explained by the objectives of policy employed in this form of the model. The industrial production index and balance of trade coefficients enter with incorrect signs, but the

Table 4.3. Results of the Burns years, 1970(2)-1978(1)

	Probability model				
	Linear[a]			Probit[b]	
Independent variable	Beta coefficient	Estimated coefficient	t-ratio	Estimated coefficient	t-ratio
Intercept	-	0.69598	-	0.54804	-
$\hat{IP}$	0.13945	8.9181	0.803	27.633	0.810
$\hat{PPI}$	-0.097983	-12.200	-0.094	-37.718	-1.021
$\hat{U}$	0.30103	0.92597*	1.759	2.9849*	1.808
$\hat{BT}$	-0.012398	-0.015251	-0.120	-0.077261	-0.210

[a]n = 96, R^2 = .05, F = 1.191.

[b]n = 96, log likelihood = -58.425, chi-square = 5.361.

coefficients are not significant at the ten percent level which suggests that these variables had little influence on monetary policy during this period. The only significant objective of policy is unemployment, but even this coefficient is only significant at the ten percent level. Other forms of the reaction function utilizing personal income as a proxy for output and the consumer price index as the price objective produced similar results.

The Volcker years, September 1979-April 1984

Table 4.4 presents the results of ordinary least squares and probit estimates of the reaction function for the Volcker years. The F-ratio and χ^2 value are significant at the one percent level and the R^2 is noticeably larger than those reported for the other two subperiods. The

Table 4.4. Results of the Volcker years, 1979(9)-1984(4)

	Probability model				
	Linear[a]			Probit[b]	
Independent variable	Beta coefficient	Estimated coefficient	t-ratio	Estimated coefficient	t-ratio
Intercept	-	0.45104	-	-0.33082	-
$\hat{IP}$	-0.24292	-13.806	-1.493	-37.729	-0.857
$\hat{PPI}$	-0.26530	-30.673***	-2.554	-105.06**	-2.021
$\hat{U}$	0.43327	1.4267***	2.728	6.6244***	2.445
$\hat{BT}$	0.054331	0.054590	0.510	-0.025379	-0.052

[a]n = 56, R^2 = .46, F = 10.883***.

[b]n = 56, log likelihood = -20.514, chi-square = 30.716***.

results suggest that the policy adoption decision was highly influenced by the policy objectives in the reaction function. All slope coefficients carry the expected sign and the coefficients of unemployment and the producer price index are significant at the five percent level or better. Most surprisingly, the beta coefficients imply that the Fed was most concerned with unemployment and to a lesser extent prices.[1] Although the coefficient of the industrial production index is not significant, the size of the beta coefficient suggests that growth in output may have influenced the policy adoption decision. In accordance with the results of most studies of Federal Reserve behavior, the balance

[1]This result may in part be due to the form of the data. U is in the form of a change in the unemployment rate, not the level of unemployment.

of trade appears to have had little or no impact on monetary policy decisions.

Summary of subperiod results classified by chairmen

The purpose of this portion of the study was twofold. First, an attempt was made to discover whether or not forecasts of the stated objectives of monetary policy influence the Fed's policy adoption decisions. Second, an attempt was made to determine the priorities of monetary policy during the Martin, Burns, and Volcker chairmanships.

The results suggest that the Fed did react to the hypothesized goals of policy in two of the three subperiods tested. However, during the Burns era (1970-1977), it has not been demonstrated that the Fed had a definable reaction function. For this period, no form of the model tested had a significant F-ratio or χ^2 value. In contrast, policy intentions were strongly influenced by both unemployment and inflation during the years when Martin and Volcker were at the helm of the Federal Reserve System.

In a sharp criticism of the strategy and tactics of the Federal Reserve, Milton Friedman stated, "Information about the name of the chairman of the Federal Reserve is of little or no use in describing the behavior of the Fed ..." [15, p. 103]. The reaction functions presented here suggest that the name of the chairman of the Fed may, in fact, be useful in describing the behavior of the Fed.

A Test of Federal Reserve Independence From the Presidential Election Cycle

There are many studies which test the hypothesis that the proximity of a presidential election systematically causes the Federal Reserve to adopt an easier monetary policy. Stated in terms of the objectives of monetary policy, preelection political pressure may cause the Fed to be concerned with growth and unemployment, while postelection freedom may allow the Fed to fight inflation. If it is true that incumbent presidents manipulate monetary policy for partisan political objectives, the implications for discretionary monetary policy are severe.[1]

An alternative hypothesis, which if sustained is equally disturbing, has not been tested in the literature. This hypothesis is that the Federal Reserve, possibly in an attempt to avoid influencing the outcome of presidential elections, fails to respond to changes in economic conditions in the preelection periods with the same enthusiasm as it does in the postelection periods. Under this hypothesis, the Federal Reserve would pursue such a noninterventionist policy prior to elections that it may fail to react to the objectives of monetary policy in a manner prescribed by economic theory. However, in the postelection periods, the Fed would be free to pursue an active monetary policy in a manner consistent with economic theory.

There is clearly a distinction between these hypotheses. In the first, monetary policy is influenced directly by partisan politics. In

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[1]The results of studies testing this hypothesis are mixed. While Tufte [45] and Laney and Willett [27] find evidence of partisan political influence on monetary policy, Luckett and Potts [29] and Wallace and Warner [49] do not.

the second, monetary policy is influenced indirectly by the election cycle in a nonpartisan manner. However, both of the hypotheses presented have one important similarity. In both scenarios, monetary policy is systematically different in preelection periods versus postelection periods. This systematic policy switching, if it exists, may create what has been termed "the political business cycle."

Previous studies of the political business cycle have often omitted evidence of cycles induced by monetary policy and instead centered on cycles induced by fiscal policy. However, Tufte [45] has asserted the existence of a political business cycle caused by monetary policy by producing evidence that monetary aggregates grow faster in the preelection biennia than the postelection biennia. This in itself actually provides little insight into the political independence of the Fed since later studies have shown that the growth rates of monetary aggregates tend to increase prior to elections because fiscal deficits grow during these same periods [27, p. 70]. Thus, the Fed may simply be passively monetizing a political fiscal cycle. For this reason, tests of these hypotheses that use monetary aggregates as the indicator of monetary policy will tend to confuse the source of the alleged political business cycle.

In light of the prior discussion, the reaction function previously developed in this chapter is particularly well suited to test these hypotheses. It directly relates monetary policy intentions to policy objectives. This reaction function then avoids the problems associated with decomposing the policy indicator into actual and intended policy.

This decomposition must be done with monetary aggregate or money market indicators [27, p. 70].

To test the more general hypothesis that the Federal Reserve's preelection reaction function differs from its postelection reaction function, equation 4.1 was estimated over the two subperiods which correspond to the preelection biennia and the postelection biennia. Equation 4.1 is reproduced below for convenience:

$$P_t = c_0 + c_1\hat{IP}_t + c_2\hat{PPI}_t + c_3\hat{U}_t + c_4\hat{BT}_t + \varepsilon_t \qquad (4.1)$$

where all variables are as defined on page 41. The timespan for this test is again 1953(2) through 1984(4) and the year base for the subperiods is November through October.

Table 4.5 presents the results of the ordinary least squares and probit estimates of the reaction function for the preelection biennia. The F-ratio and χ^2 value are significant at the one percent level. All of the coefficients carry the expected sign except the balance of trade. However, only the coefficient on unemployment is significant, and then only at the ten percent level.

Table 4.6 presents the results of the ordinary least squares and probit estimates of the reaction function for the postelection biennia. The F-ratio and x^2 value are highly significant. All slope coefficients enter with the expected sign. The coefficients of both the producer price index and unemployment are significant at the one percent level.

Table 4.5. Results of preelection biennia, 1953(2)-1984(4)

Independent variable	Probability model: Linear[a] Beta coefficient	Linear[a] Estimated coefficient	Linear[a] t-ratio	Probit[b] Estimated coefficient	Probit[b] t-ratio
Intercept	-	0.45923	-	-0.10113	-
$\hat{IP}$	-0.058307	-3.6433	-0.503	-11.116	-0.563
$\hat{PPI}$	-0.0018521	-0.25948	-0.025	1.5546	0.057
$\hat{U}$	0.20462	0.66598*	1.779	1.7926*	1.774
$\hat{BT}$	-0.068753	-0.10542	-0.947	-0.30109	-1.004

[a]n = 186, R^2 = .07, F = 3.500***.

[b]n = 186, log likelihood = -120.83, chi-square = 14.043***.

Table 4.6. Results of postelection biennia, 1953(2)-1984(4)

Independent variable	Probability model: Linear[a] Beta coefficient	Linear[a] Estimated coefficient	Linear[a] t-ratio	Probit[b] Estimated coefficient	Probit[b] t-ratio
Intercept	-	0.56051	-	0.20589	-
$\hat{IP}$	-0.067516	-5.6750	-0.709	-18.817	-0.776
$\hat{PPI}$	-0.22443	-27.229***	-3.308	-80.166***	-3.295
$\hat{U}$	0.27009	0.99516***	2.812	3.0026***	2.769
$\hat{BT}$	0.064346	0.086915	0.956	0.25287	0.951

[a]n = 189, R^2 = .18, F = 10.004***.

[b]n = 189, log likelihood = -112.74, chi-square = 37.586***.

A visual inspection of these tables suggests that there is a considerable difference in these two periods. The R^2, F-ratio, and χ^2 value are all much larger in the postelection periods. This implies that a greater percentage of the variance in the policy indicator was explained by the forecast objectives in the postelection periods when compared with the preelection periods. Also, the individual coefficients generated in the postelection periods have higher t-ratios than their counterparts in the preelection periods.

The difference in these two subperiods is so pronounced that tests of structural change of the slope vectors were performed on the reaction functions. The results of the structural change tests for the linear and probit reaction functions imply the following: the hypothesis that the slope coefficients for the pre- and postelection periods are the same is rejected at the 25 percent and ten percent levels, respectively.[1]

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[1]The test of structural change in the linear probability model is:

$$F = \frac{(SSE_R - SSE_U)/(k-1)}{SSE_U/(n-2k)} \sim F^{k-1}_{n-2k}$$

where k = number of parameters in the restricted model, and
n = number of observations in the restricted model.

$$F = \frac{(83.206 - 81.645)/4}{81.645/365} = 1.75$$

which is significant at the 25 percent level.

The test for structural change in the probit probability model is:

$$\chi^2 = -2[L_R - (L_1 + L_2)] \sim x^2_q$$

where L_R = value of the log likelihood for the restricted model,
L_1, L_2 = value of the log likelihood for the unrestricted models, and
q = the number of restrictions.

$$\chi^2 = -2[-237.74 - (-120.83 - 112.74)] = 8.34$$

which is significant at the ten percent level.

Although these results are not definitive, they do suggest that the Fed systematically reacts differently to changes in economic conditions in preelection versus postelection periods.[1]

To carry the analysis one step further, it should be determined which, if either, of the original hypotheses is evidenced by these results. That is, do the differences that appear in the pre- and postelection results suggest that they were caused by direct partisan influence or preelection self-restraint on the part of the Fed?

Since the inflation objective gains importance in the postelection period, one might be tempted to assert that partisan politics are the cause. However, the unemployment objective also gains importance in the postelection period when compared with the preelection period. This is clearly not the result one would expect if the Fed were dominated by partisan political pressures.

For whatever reason, it appears the Fed has simply failed to react to the objectives of policy in the preelection periods with the same zeal as it has in the postelection periods. This may be an attempt by the Fed to avoid any undue influence on an upcoming presidential election, or it may be the result of a central bank that is intimidated by a political system from which it is trying to maintain its independence.

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[1]Although other forms of the reaction functions using personal income and the consumer price index produced similar regression results, the tests of structural change were sensitive to the form chosen. The form of the reaction function reported here shows the greatest change in structure. In addition, reaction functions based on actual instead of forecast data did not show as large a structure change.

The results presented here suggest that the Federal Reserve's policy response to forecasts of the objectives of monetary policy is different during the pre- versus postelection biennia. However, an analysis of the reasons why this is the case is a subjective task.

CHAPTER V. AN ANALYSIS OF THE IMPACT OF A CHANGE IN OPERATING STRATEGY ON THE PRIORITIES OF MONETARY POLICY

On October 6, 1979, the Federal Reserve announced a series of actions intended to reduce inflationary momentum and inflationary expectations. The action that has gained the greatest notice was "A change in the method used to conduct monetary policy ... [which] involves placing greater emphasis in day-to-day operation on the supply of bank reserves and less emphasis on confining short-term fluctuations in the federal funds rate" [13, October 1979, p. 830]. This action has been interpreted by economists as a fundamental change in the operating strategy of the Fed.

It is apparent that the outcome of monetary policy has changed since the Fed moved from a money market strategy to a monetary aggregate strategy. The growth rates of monetary aggregates have been slower and the variability of interest rates has been greater. The economy first reflected the impact of this strategy change with rising unemployment, negative growth, and a reduction in the rate of inflation. The economy has since rebounded with falling unemployment, modest growth, and relatively stable prices.

Although the results of monetary policy before the change in strategy clearly differ from the results after the change in strategy, the objectives and priorities of monetary policy may have remained the same. That is, it is quite possible that the Fed is simply better able to gain results with the new operating strategy than with the old operating strategy, while the intentions of policy have remained unchanged. Alternatively, a new priority system may have been ushered in along with the change in operating procedure. This would suggest that the change in the outcome of monetary policy may not be due solely to the change in strategy, but due to a change in priorities as well.

To test the hypothesis that the objectives and priorities of monetary policy changed in October 1979, a reaction function similar to that developed in Chapter IV will be employed. However, there are some differences in the method used to forecast the objectives of policy.

Recall that the forecasts used in Chapter IV were the predicted values from a fixed-coefficient VAR model. This forecasting method can be criticized because information was used to generate the forecasts that was not available to the monetary authorities at the time they made their forecasts. To avoid this problem, a VAR model of the form of equation 3.6 (p. 36) was reestimated each month of the sample period using only the preceding 60 months of data (60 months of data prior to the relevant FOMC policy adoption decision). Each monthly estimation was used to forecast the target variables for one month of the sample period. Thus, the forecasting coefficients are allowed to vary from month to month based on the past 60 months of information. By utilizing a variable-coefficient VAR model on past data, the forecasts of the target variables are true forecasts.

The data used in the forecasting equations are monthly values of personal income, the industrial production index, the consumer price index, the producer price index, the unemployment rate, the balance of trade surplus, the M1 money supply, the three-month Treasury bill rate, the dollar/G-10 exchange rate, and the fiscal surplus.[1] To assure stationarity, all data series were first differenced. The transformed data were utilized in a third-order variable-coefficient VAR model of the form of equation 3.6 (p. 33).[2] The forecasts generated from this model will be denoted ($\hat{}$).

Table 5.1 shows the correlation between the forecast value and the actual value of the target variables. Again, this does not provide

Table 5.1. Correlation between actual and predicted values of the target variables generated from a variable-coefficient VAR model: 1974(1)-1984(5)

Target variable	Correlation
1. Personal income ($\widehat{PI}$)	.86
2. Industrial production index ($\widehat{IP}$)	.93
3. Producer price index ($\widehat{PPI}$)	.83
4. Consumer price index ($\widehat{CPI}$)	.92
5. Unemployment ($\hat{U}$)	.88
6. Balance of trade ($\widehat{BT}$)	.93
7. Exchange rate ($\widehat{ER}$)	.85

[1]The dollar/G-10 exchange rate, the fiscal surplus, and the balance of trade were obtained from various issues of the Federal Reserve Bulletin. The dollar/G-10 exchange rate is a trade weighted exchange rate of the dollar versus the currencies of ten industrialized trading partners.

[2]No test was performed for the optimal number of lags because no system log likelihood test exists for repeated estimation of a VAR model. Therefore, the choice of three lags on each of ten variables in the VAR model was somewhat arbitrary. Since only 60 months of data were available for each estimation, it was felt that no more than 30 slope coefficients should be estimated. Also, first differenced data were used because these transformed data were stationary within any 60-month period.

information about how closely these forecasts correlate with the Fed's actual forecasts, because the Fed's actual forecasts cannot be obtained.

The target variables can be placed into the four categories of the objectives of monetary policy:

1) growth in output--$\hat{PI}$ or $\hat{IP}$,

2) price stability--$\hat{PPI}$ or $\hat{CPI}$,

3) unemployment--$\hat{U}$, and

4) international balance--$\hat{BT}$ or $\hat{ER}$.

Two output, two price, and two international variables can be combined into eight combinations. For this reason, eight forms of the reaction function were estimated. However, to avoid the reporting of redundant results, only one form is reported in this chapter. It is of the following structure:

$$P_t = d_0 + d_1\hat{IP}_t + d_2\hat{CPI}_t + d_3\hat{U}_t + d_4\hat{BT}_t + \delta_t \tag{5.1}$$

where P = policy indicator, 0 = tight money, 1 = easy money;

$\hat{IP}$ = forecast value of the change in the industrial production index;

$\hat{CPI}$ = forecast value of the change in the consumer price index;

$\hat{U}$ = forecast value of the change in the unemployment percentage;

$\hat{BT}$ = forecast value of the change in the balance of trade surplus;

δ = error term.

Because the industrial production index is a real variable, it was again used as the proxy for growth. The choice of an inflation proxy and an international balance proxy was somewhat arbitrary because the results were not sensitive to these choices.

To test the hypothesis that the objectives and priorities of monetary policy changed in October 1979, equation 5.1 was estimated as a linear probability model and as a probit probability model for the two subperiods of January 1974 through September 1979 and October 1979 through May 1984.

Table 5.2 presents the results of ordinary least squares and probit estimates of the reaction function for the subperiod of January 1974 through September 1979. Neither the F-ratio nor the χ^2 value are significant at the ten percent level, therefore the hypothesis that all slope coefficients equal zero cannot be rejected. In addition, the small R^2 suggests that very little of the variance in the policy indicator is explained by the forecasts of the objectives of policy. All coefficients enter with the expected sign except the coefficient of the balance of trade. However, only the coefficient of the consumer price index is significant at the ten percent level.

Table 5.3 presents the ordinary least squares and probit estimates of the reaction function for the subperiod of October 1979 through May 1984. The F-ratio and χ^2 value are highly significant, which suggests that the policy-adoption decisions were heavily influenced by the forecasts of the policy objectives. The coefficients of the industrial production index, consumer price index, and unemployment are all highly significant and carry the expected signs. The coefficient of the balance of trade surplus entered with the expected sign, but this coefficient was

Table 5.2. Results of the 1974(1)-1979(9) subperiod

	Probability model				
	Linear[a]			Probit[b]	
Independent variable	Beta coefficient	Estimated coefficient[c]	t-ratio	Estimated coefficient	t-ratio
Intercept	-	0.83712	-	0.89901	-
$\hat{IP}$	-0.041339	-0.016691	-0.254	-0.057136	-0.322
$\hat{CPI}$	-0.22212	-0.21410*	-1.821	-0.56858*	-1.835
$\hat{U}$	0.11248	0.27952	0.691	0.82206	0.750
$\hat{BT}$	-0.0090346	$-7.7829 \cdot 10^{-6}$	-0.074	$-1.5623 \cdot 10^{-5}$	-0.057

[a] $n = 69$, $R^2 = .06$, $F = 1.072$.

[b] $n = 69$, log likelihood = -44.336, chi-square = 4.519.

[c] *, **, and *** appearing in Tables 5.2 and 5.3 indicate significance at the 10, 5, and 1 percent levels, respectively. t-tests are two-tailed while F and χ^2 tests are one-tailed.

Table 5.3. Results of the 1979(10)-1984(5) subperiod

	Probability model				
	Linear[a]			Probit[b]	
Independent variable	Beta coefficient	Estimated coefficient	t-ratio	Estimated coefficient	t-ratio
Intercept	-	0.62021	-	0.49617	-
$\hat{IP}$	-0.43780	-0.13239***	-3.250	-0.56820**	-2.621
$\hat{CPI}$	-0.34171	-0.16545***	-3.537	-0.65252**	-2.633
$\hat{U}$	0.28952	0.71681**	2.147	3.4899*	1.881
$\hat{BT}$	0.064106	$1.9799 \cdot 10^{-5}$	0.665	$8.0776 \cdot 10^{-5}$	0.523

[a] $n = 56$, $R^2 = .53$, $F = 14.409$***.

[b] $n = 56$, log likelihood = -17.655, chi-square = 36.433***.

not significant. The beta coefficients suggest that growth in output received the highest priority, followed by stable prices and unemployment.[1]

Since a visual inspection of Tables 5.2 and 5.3 suggests that these two periods are characterized by different priorities, a test of structural change was performed on the reaction functions. The results of the structural change tests for the linear and probit reaction functions imply the following: the hypothesis that the slope coefficients for the subperiods of 1974(1)-1979(9) and 1979(10)-1984(5) are the same is rejected at the ten and one percent levels, respectively.[2] Although

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[1]The results presented in Table 5.3 differ somewhat from those generated for a similar subperiod reported in Table 4.4. This may be due to several factors. First, the reaction function presented in this chapter utilized the CPI for the price stability objective, while the reaction function in the preceding chapter utilized the PPI. If the correlation of the CPI and IP is less than the correlation of the PPI and IP, reaction functions fitted with the CPI may allow the significance of IP to rise. Second, the form of the data differs between these two reaction functions: growth rates versus first differences of the levels. Third, the methods of data generation differ: fixed-coefficient VAR versus variable-coefficient VAR.

[2]The test of structural change in the linear probability model is:

$$F = \frac{(SSE_R - SSE_U)/(k-1)}{SSE_U/(n-2k)} \sim F^{k-1}_{n-2k}$$

where all variables are as defined on page 52.

$$F = \frac{(23.100 - 21.486)/4}{21.486/115} = 2.16$$

which is significant at the ten percent level.

The test for structural change in the probit probability model is:

$$\chi^2 = -2[L_R - (L_1 + L_2)] \sim \chi^2_q$$

these results are not definitive, it does appear that the priorities of monetary policy did change when the new operating procedures were announced.[1]

The results suggest that the Fed may have suffered from a lack of direction or purpose during the middle and late 1970s. This is evidenced by the fact that no form of the reaction function tested over the 1974(1) through 1979(9) subperiod had a significant F-ratio or χ^2 value. However, after the announcement of the new operating procedures, there appears to exist a definite set of priorities used by the monetary authorities. This is demonstrated by all of the supporting statistics to the 1979(10) through 1984(5) subperiod reaction function.

It should be noted that a singular source of the change in priorities of monetary policy cannot be determined from the preceding test. Two nearly concomitant events took place in 1979: the appointment of Paul Volcker as chairman of the Board of Governors, and two months later the announcement that the Fed would begin targeting monetary aggregates. It is reasonable that these two events should be viewed as one. That is, the appointment of Volcker as chairman and the methods he espoused may be inseparable. If this view is accepted, the choice of September/October 1979 as the breaking point of the reaction function

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where all variables are as defined on page 52.

$$\chi^2 = -2[-69.604 - (-44.336 - 17.655)] = 15.226$$

which is significant at the one percent level.

[1]All forms of the reaction function tested showed structural change at the ten percent level or better.

becomes somewhat arbtirary. However, there is little doubt that these events have marked the beginning of a period where the objectives and priorities of the monetary authorities are well defined.

CHAPTER VI. SUMMARY OF THE FORECASTING METHODS

This study utilized two methods of data generation: a fixed-coefficient VAR model and a variable-coefficient VAR model. Tables 4.1 and 5.1 express the correlations between the actual and predicted values of the data generated from these two models. Clearly, the variable-coefficient VAR model performed better than the fixed-coefficient VAR model. There are three reasons why this is the case. First, the fixed-coefficient VAR model utilized data that were filtered to a greater degree (i.e., the transformations for stationarity were more severe). This results in a data series with no trend. Furthermore, the correlations in Table 4.1 are based on the transformed data. If the data had been coverted back into levels, the correlations would appear much higher. Second, the variable-coefficient VAR model contained two variables that were unavailable for the full sample period: the fiscal surplus, and the dollar/G-10 exchange rate. These variables may have added to the accuracy of the variable-coefficient VAR model. Third, the true relationships between the variables in the vector may not be time invariant, which would suggest that the variable-coefficient VAR model should perform better than the fixed-coefficient VAR model.

Although it would have been desirable to use a variable-coefficient VAR model to create all of the forecasts, the costs associated with this method of data generation were prohibitive. Therefore, the variable-coefficient VAR model was only used for the 1974-1984 subperiod.

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